FARM POWER AND MACHINERY COSTS IN ALBERTA 1950

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Canada
DEPARTMENT OF AGRICULTURE
Marketing Service - Economics Division
Ottawa, September, 1952

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SUMMARY

Increasing mechanization of Alberta farms has resulted in more attention being paid to efficiency in machine use. With efficiency of use of farm machinery as a theme, this study was undertaken during the summer of 1950. Data covering the use and cost of using 17 common farm machines were collected from 203 farms located on the four most fully developed soil zones of Alberta. The following six points are listed as the more important findings and conclusions.

1. The acres annually covered by the average field machines ranged from 74 acres for 3-bottom plows to 1,067 acres for the 14 foot blade weeder. The average acres or hours of use of the implements varied with districts and with individual farms.

2. Tractor use varied from 40 to 1,400 hours per year, with an average of 526 hours for 256 tractors. There were 150 tractors used less than the average and 106 tractors with more than the average use.

3. Combine use ranged from 20 to 380 hours with the average of 87 combines being 136 hours. There were 50 combines used less, and 37 used more, than the average.

4. As is shown by Figure 5, the annual hours or acres of use a machine performs has a decided bearing on the cost per unit of service. Total cost per unit of service decreases as the units of use increase. One effective method of increasing the use of machines is the practice of doing custom work for neighbouring farmers.

5. Production costs may be lowered by prolonging the useful life of a machine. Co-operative use of farm machinery is found by some farm operators to be another method of lowering capital and overhead costs.

6. The type of farming and the farming practices vary with the soil zones of Alberta. However, there is little difference among comparative costs of field operations per acre of crop covering summerfallow and spring work. Comparative costs were found to be \$2.11, \$1.82, \$2.32 and \$2.29 per acre of crop for the brown, dark brown, shallow black and black soil zones respectively.

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INTRODUCTION

The degree of mechanization of Alberta farms is, and has been, increasing over the past quarter of a century. World War II, with its demand for increased production of Canadian resources, found that, despite manpower shortages, Agriculture's resources were capable of continuing or increasing in output. This was made possible partly through an increase in mechanization. The number of Alberta farms with tractors increased nearly 16 per cent over the period 1941-46 (see Table 1). Over this same period the number of horses per Alberta farm decreased nearly 25 per cent, as is shown in Table 2. This

Table 1.- Number of Tractors on Alberta Farms, 1926-1946

Year	Farms with tractors	Number of tractors	Number of farms in Alberta	Per cent of farms with tractors	Number of tractors per farm, of farms with tractors
1926	10,225	11,311	77,130	13.26	1.11
1931	21,994	23,967	97,408	22.58	1.09
1936	22,947	24,922	100,358	22.86	1.09
1941	34,456	36,445	99,732	34.55	1.06
1946	45,205	48,756	89,541	50.49	1.08

Source: Brownlee, H.P., Alberta Facts and Figures, Department of Industries and Labour, Province of Alberta, Edmonton, Alberta, 1950.

decrease has freed land for the grazing of other livestock as well as enabling the farmer to have a greater number of acres of grain for sale or for livestock feed. The time which was spent on caring for horses can now be spent on other farm work or is available for recreation. It is not uncommon, especially during spring work, to find tractor power being used 24 hours a day, which is not practical when horses are the source of power. While this increased mechanization has brought about greater production with the same or less labour, it has also resulted in a relatively higher cash cost for machine operation in farm production.

Table 2.- Number of Horses on Alberta Farms, 1926-1946

Year	Number of horses	Number of farms in Alberta	Number of horses per farm
1926	784,300	77,130	10.17
1931	731,700	97,408	7.51
1936	677,000	100,358	6.75
1941	649,200	99,732	6.51
1946	469,000	89,541	5.24

Ibid.

The purpose of this study was to bring up to date available data on the use and the cost of use of some farm machines commonly used in Alberta, and to this end attention has been specifically directed to determine:

(i) The use made of 17 common farm machines

(ii) The cash operating costs of these machines

(iii) The capital costs of owning them

(iv) Equitable charges for custom use of farm machinery

(v) Comparative costs of typical sequences of field operations.

AREA COVERED BY THE STUDY

Alberta has been divided into six soil zones, namely: the brown, the dark brown, the shallow black, the black, the transition, and the gray wooded. The transition and gray wooded zones were not included in this study as they are still predominantly a pioneering area with small farms and a low degree of mechanization. The area covered by this study was selected to be representative of the varying farming practices of the other four zones of the province (see map 1/), with data being obtained from 203 farms.

The brown and dark brown soil zones are predominately a wheat area. The black and shallow black soil zones are a mixed grain-livestock farming area. The wheat area is the prairie zone while the mixed farms are common to the parkland.

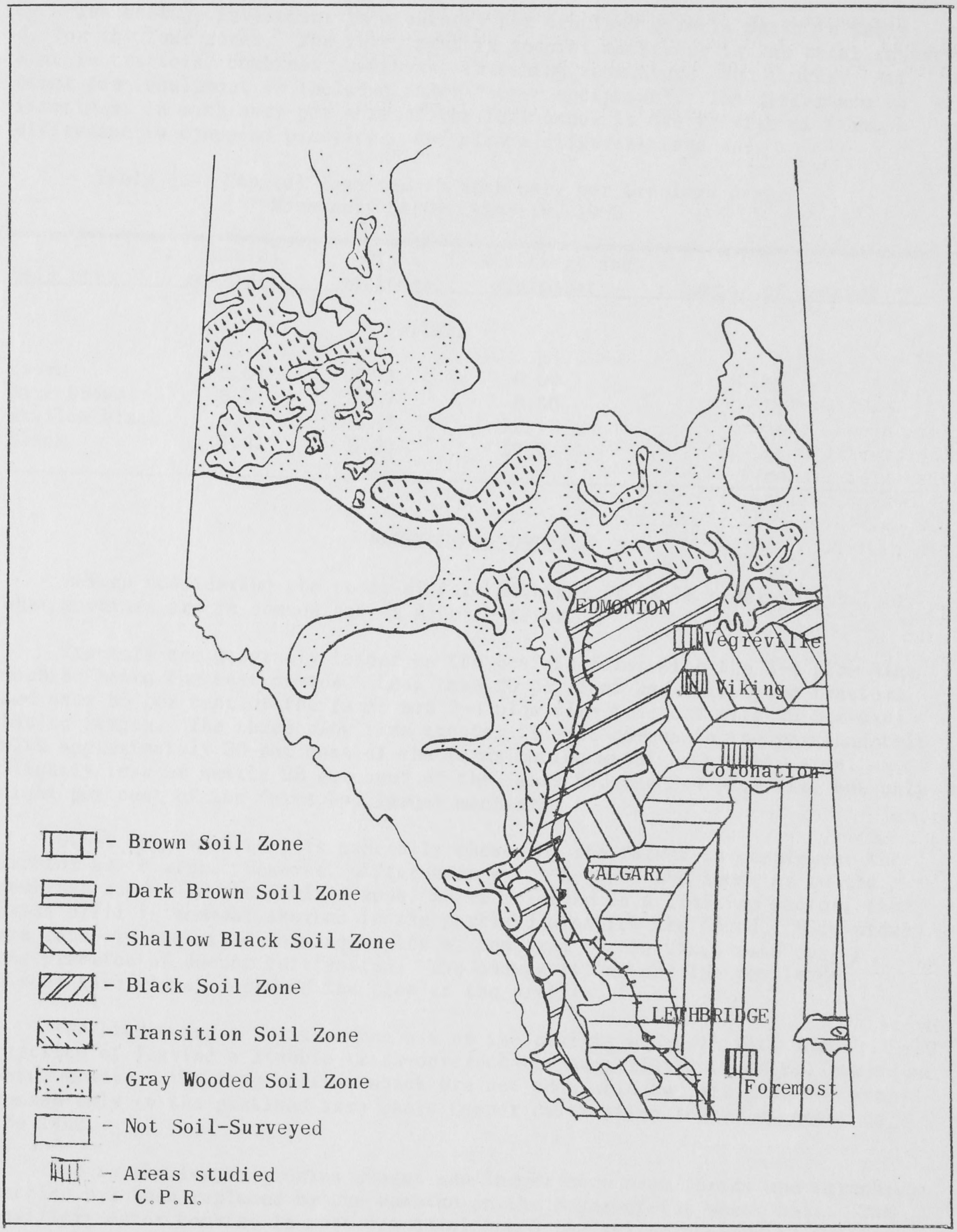
SIZE OF FARMS

The average size of the surveyed farms in the brown soil zone was 1,096 acres with 941 acres of cropland; in the dark brown soil zone 927 acres with 517 acres of cropland; in the shallow black soil zone 784 acres with 394 acres of cropland. The smallest farms were in the black soil zone, averaging 481 acres and a crop acreage of 357 acres (Table 3).

Table 3.- Total Size and Cropland Acreage of the Average Farm in the Different Soil Zones, Covered by Machinery Study, Alberta, 1950

Soil zone	Total size	Acres cropland	Number of Farms in sample
	- acres -		
Brown	1,096	941	59
Dark brown	927	517	43
Shallow black	784	394	59
Black	481	357	42

1/ The soil zones as delineated are based upon a map of the soil zones of Alberta as established by Alberta Soil Surveys conducted by the Department of Soils, University of Alberta, Dominion Experimental Farms Service, Alberta Research Council and the Alberta Department of Agriculture.



Soils Map Showing Location of Areas Covered by Machinery Study,
Alberta 1950

The average investment in machinery per cropland acre is shown in Table 4, for the four zones. The investment in special machinery is the total investment in tractors, combines, swathers, threshing separators, and trucks. All other farm equipment is included under "other equipment". The difference in investment in machinery per acre of the four zones is due to size of farm, a difference in cropping practices, and also a different land use.

Table 4.- Capital Invested in Machinery per Cropland Acre, Machinery Study, Alberta, 1950

Soil zone	Special machinery	Other equipment	Machinery and equipment	Number of records
		- dollars -		
Brown	5.07	2.93	8.00	40
Dark brown	5.51	3.37	8.88	34
Shallow black	6.70	5.47	12.17	59
Black	7.41	5.00	12.41	42

MACHINES REPORTED

Before considering the costs of farm machines it is in order to consider what machines are in common use on Alberta farms.

Tractors are generally larger on the prairie farms with the 3-4 plow size machine being the most common. Less than 20 per cent had three plow tractors and over 35 per cent of the farms had 3-4 plow size tractors with 25 per cent having larger. The three plow size tractor is most common in the parkland belt with approximately 30 per cent of the farms having machines of this size. Slightly less or nearly 28 per cent of the farms had the 3-4 plow size but only eight per cent of the farms had larger machines.

Other farm machinery is generally chosen by the farmer to complement the tractor as to size. However, differences exist between the areas as to the machines used. In the prairie zone, where moisture is a limiting factor, the press drill is common, whereas in the parkland area few are found. More plows are found in the mixed farming region as compared to the wheat zone due to the practice of deeper cultivation. The oneway tiller and the new larger discer have almost replaced the plow on the prairie.

The blade weeder is in common use on the prairie where it fits the practice of leaving a stubble trash-cover on the summerfallow. On the other hand, however, the drag harrows which are not adaptable to this practice are common only to the parkland area where deeper cultivation leaves no cover on the land.

Due to the longer growing season and larger more even fields the threshing machine has been replaced by the combine on the farms of the wheat belt. The auxiliary motor combine is most common although the self-propelled is gaining in popularity. In the parkland, however, where the growing season is shorter

and fall rains are common, binders and threshing machines are still generally used.

Cost figures were obtained for 17 common farm machines including tractors and trucks. Table 5 lists the machines for which cost data were obtained. All of these machines are common to the area as a whole with the exception noted above.

Table 5.- Summary of Data Reported, Machinery Study, Alberta, 1950

Machine	Size	Number of co-operators having machine	Present age	Total estimated years of use	Days used per year	Average 1950 replacement cost	Present value
			- years -			- dollars -	
Power:							
Tractors	- plow -						
Gas	1 to 2-3	59	4.1	13.9	53.1	1,843	1,230
Distillate	1 to 2-3	11	6.6	14.4	54.4	2,532	739
Gas	3 & 3-4	79	8.4	16.6	54.5	2,364	1,124
Distillate	3 & 3-4	50	7.2	14.5	51.3	2,956	1,382
Gas	4 and up	25	4.5	13.4	61.5	3,555	2,158
Diesel	4 and up	19	1.4	11.1	66.7	4,561	3,462
	- tons -			- miles -			
Trucks	½ - ¾	44	5.4	61,524	9,844	1,807	1,055
	1	26	4.8	59,391	7,574	2,158	1,390
	1½ - 2	34	9.6	92,212	6,026	2,699	977
	2½ - 3	16	3.6	76,445	10,583	3,198	1,756
Tillage Machines:							
Blade weeders	11'	14	5.3	13.4	15.7	459	203
	14'	5	2.0	15.0	22.6	568	480
Cultivators	7 - 7½'	8	6.4	17.8	13.8	221	129
	8'	19	12.9	20.3	13.2	245	69
	10 - 10½'	26	7.8	17.3	11.7	306	174
	11½ - 12'	18	7.3	16.2	11.0	341	191
	14 - 14½'	10	6.1	13.2	11.3	438	194
Discs (single)	14 - 15'	7	16.3	21.3	4.9	260	71
	20 - 21'	12	8.9	17.0	6.0	325	142
Discs (double)	7'	6	9.7	19.2	11.5	231	106
	8'	26	15.5	22.0	46.1	252	59
	10'	22	10.7	20.6	78.2	352	160
Drills	10'	43	11.0	20.7	7.3	512	162
	12'	24	8.5	18.4	5.7	568	255
	14'	15	6.9	15.4	8.0	654	313

- Continued -

Table 5.- Summary of Data Reported, Machinery Study, Alberta, 1950 - Continued

Machine	Size	Number of co-operators having machine	Present age	Total estimated years of use	Days used per year	Average 1950 replacement cost	Present value
			- years -			- dollars -	
Drills (press)	10'	12	5.4	11.6	13.5	652	330
	14'	9	4.1	10.1	9.2	804	423
Harrows	15'	14	15.9	28.9	5.6	55	22
	18'	25	11.5	27.0	5.8	66	28
	20 - 21'	19	12.7	22.8	7.3	77	36
	24 - 25'	19	13.5	26.2	4.3	88	50
	30'	10	11.7	26.4	3.6	110	65
Oneways	4½'	26	5.3	13.4	16.1	562	262
	6'	55	6.6	13.8	19.2	623	310
	8'	43	5.4	13.4	20.6	704	393
	8½ - 9'	32	8.2	14.7	22.6	720	295
	9½ - 10'	20	5.6	12.3	24.6	722	391
Packers	8 - 9'	9	11.2	22.2	12.6	184	77
	9½ - 11'	8	10.9	22.7	9.1	214	61
	- bottom -						
Plows	2	19	7.0	19.4	9.0	238	103
	3	37	10.7	22.5	6.0	324	153
	4	18	9.7	19.4	6.2	444	307
Rod weeders	12'	9	6.0	15.0	10.1	189	110
	24'	10	3.0	11.4	12.5	396	232
Harvesting machines:							
Binders	7'	30	13.4	18.4	6.9	492	112
	8'	53	12.4	18.0	7.0	562	159
	10'	18	8.3	16.4	7.2	727	325
Combines A.M.	12'	16	9.4	16.2	13.6	3,322	1,183
	16'	8	15.7	18.0	9.6	5,025	182
	20'	12	5.7	14.2	15.0	5,735	2,696
S.P.	12'	10	2.2	8.7	20.6	4,269	2,866
	14'	14	3.1	9.3	20.7	4,675	3,096
	15'	5	1.8	7.6	13.6	4,452	3,356
Swathers	12'	12	3.1	14.6	3.8	683	366
	16'	8	4.4	10.6	8.5	909	504
Threshing machines	28"	23	22.0	29.0	10.4	2,444	605

ANNUAL MACHINE USE

The acres annually covered by the average field machines ranged from 74 acres for 3-bottom plows to 1,067 acres for the 14 foot blade weeder. The average acres or hours of use of the implements varied with districts and with individual farms. The use of a given machine depends upon, among other things: the crops grown, the crops' acreages, the precipitation and its resultant weed growth, the machines available on individual farms, and the farm operator's preference for particular machines.

Figure 1 shows the distribution of tractors by hours of use. Tractor use varied from 40 to 1,400 hours with an average of 526 hours for 256 tractors. There were 150 tractors used less than the average and 106 tractors with more than the average use.

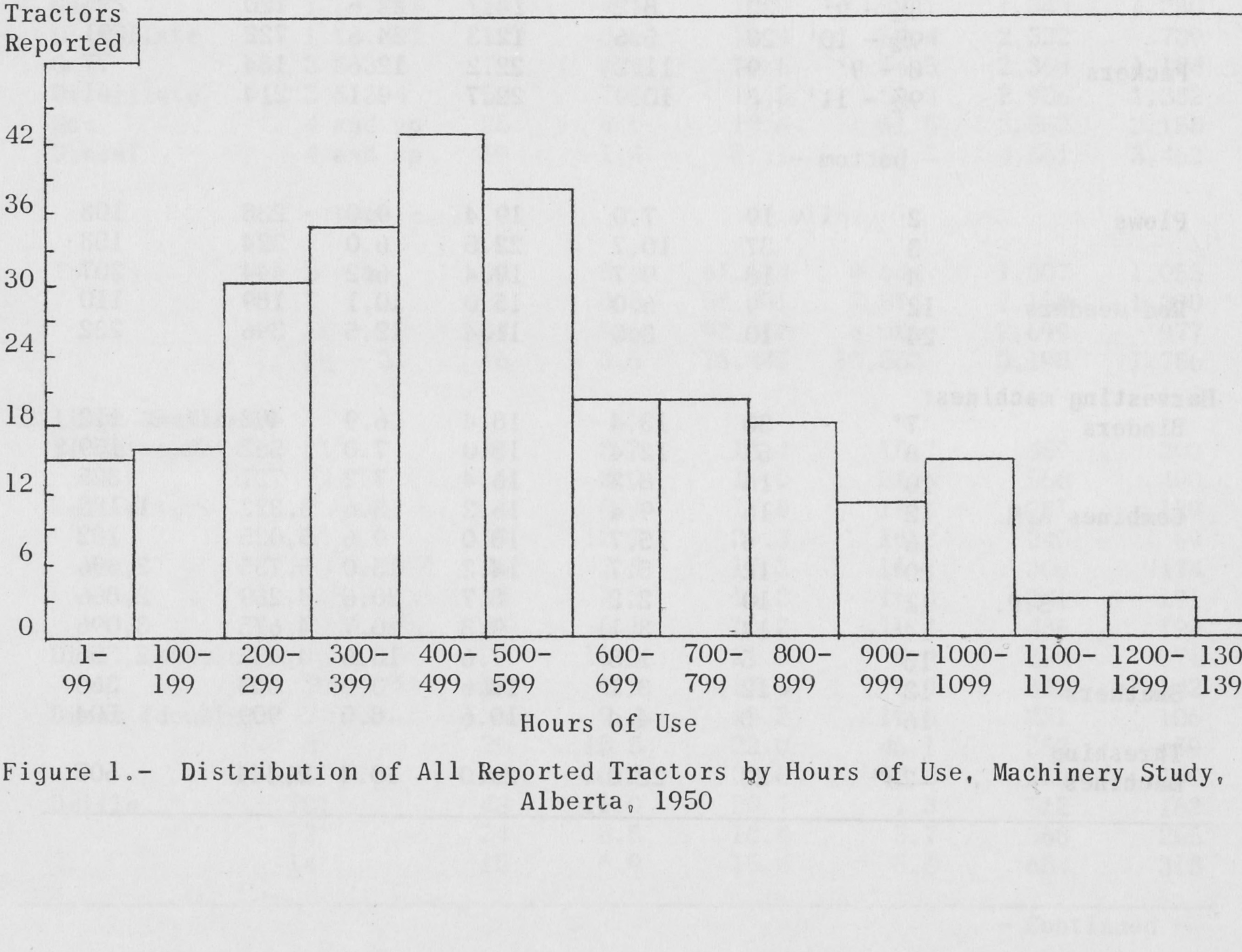


Figure 1.- Distribution of All Reported Tractors by Hours of Use, Machinery Study, Alberta, 1950

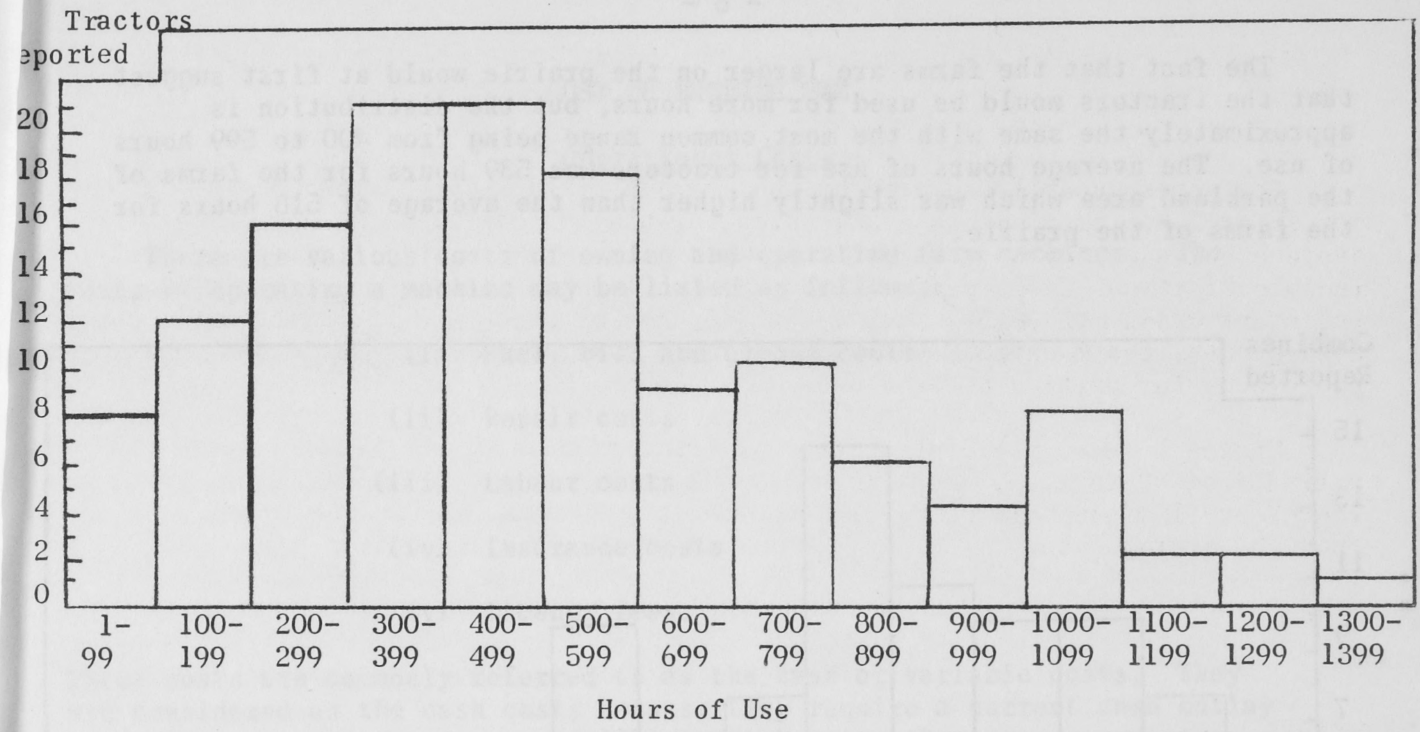


Figure 2.- Distribution of Tractors Reported by Hours of Use in the Prairie Zone, Alberta, 1950

The distribution of tractors by hours of use for the wheat farms of the brown and dark brown soil zones is shown in Figure 2, while the distribution for the mixed farms of the shallow black and black soil zones is shown in Figure 3.

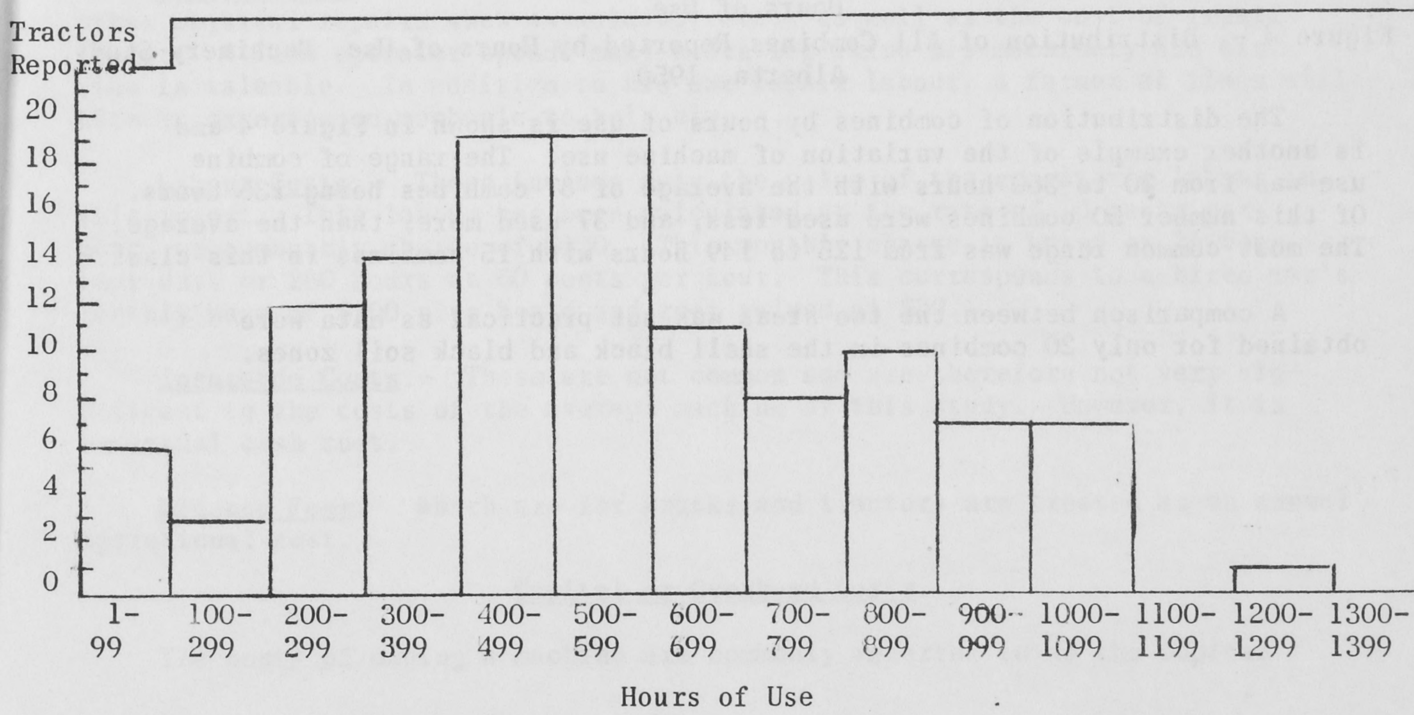


Figure 3.- Distribution of Tractors Reported by Hours of Use in the Parkland Zone, Alberta, 1950

The fact that the farms are larger on the prairie would at first suggest that the tractors would be used for more hours, but the distribution is approximately the same with the most common range being from 400 to 599 hours of use. The average hours of use for tractors was 539 hours for the farms of the parkland area which was slightly higher than the average of 516 hours for the farms of the prairie.

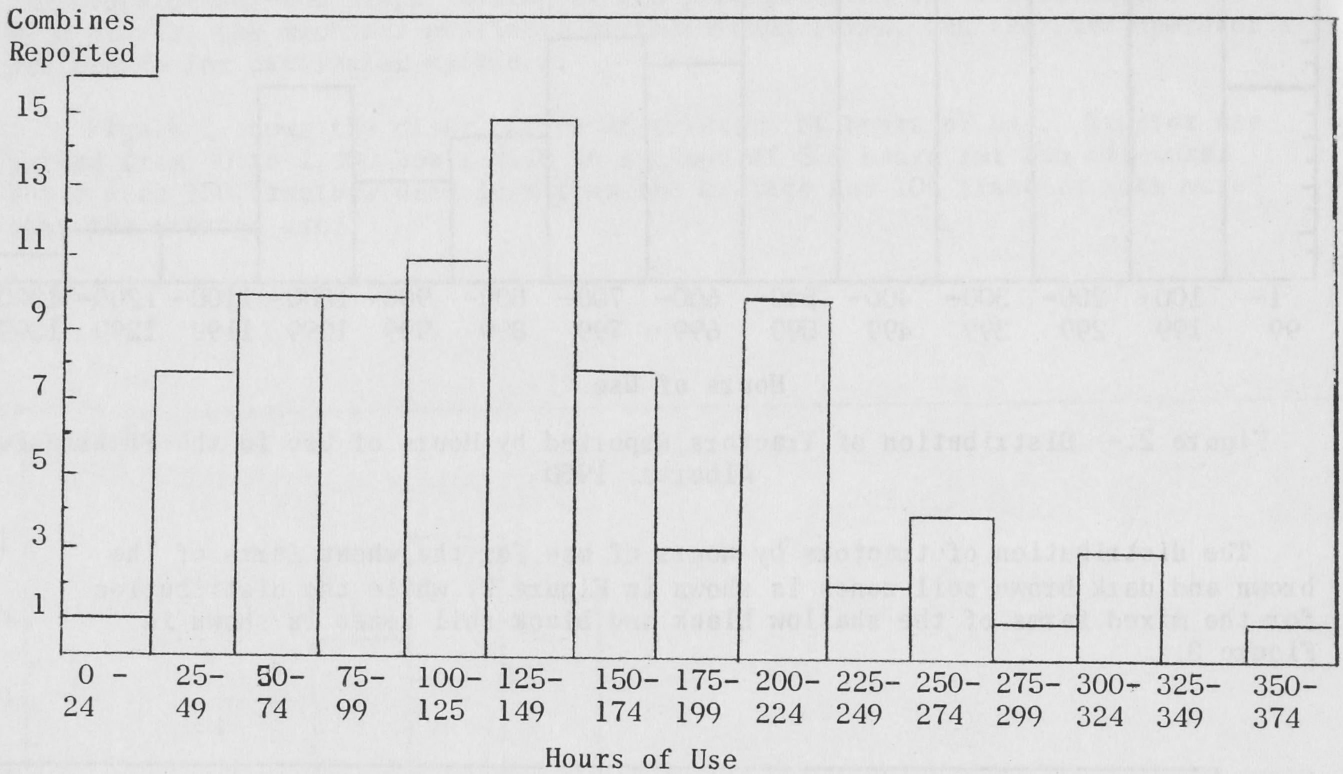


Figure 4.- Distribution of All Combines Reported by Hours of Use, Machinery Study, Alberta, 1950

The distribution of combines by hours of use is shown in Figure 4 and is another example of the variation of machine use. The range of combine use was from 20 to 380 hours with the average of 87 combines being 136 hours. Of this number 50 combines were used less, and 37 used more, than the average. The most common range was from 125 to 149 hours with 15 combines in this class.

A comparison between the two areas was not practical as data were obtained for only 20 combines in the shall black and black soil zones.

COST OF MACHINE USE

Operational Costs

There are various costs of owning and operating farm machines. The costs of operating a machine may be listed as follows:

(i) Fuel, oil, and grease costs

(ii) Repair costs

(iii) Labour costs

(iv) Insurance costs

(v) Licence fees.

These costs are commonly referred to as the cash or variable costs. They are considered as the cash costs because they require a current cash outlay by the farm operator and as a variable cost because they are dependent upon the hours the machines are operated. Licence fees and insurance costs are not variable in that they do not vary with use, but they are considered with the other operational expenses in that they are current cash costs.

Fuel, Oil and Grease Costs.- These vary with use as do the other variable cash costs. In addition, the cost of fuel, oil, and grease varies with districts and years. In this study average cost figures, based upon 1950 prices, were used.

Repair Costs.- These include the costs of both parts purchased and other physical repairs such as welding, etc., as well as the cost of repair labour. A farm operator spends many hours repairing his machinery and his time is valuable. In addition to his own repair labour, a farmer at times will hire an experienced mechanic to help him.

Labour Costs.- These include only the value of the operator's labour in this report. This labour has been calculated at the rate of 50 cents per hour, or a monthly charge of $130. This monthly charge is based on 26 ten-hour days or 260 hours at 50 cents per hour. This corresponds to a hired man's monthly wage of $100 plus board and room valued at $30.

Insurance Costs.- These are not common and are therefore not very significant to the costs of the average machine of this study. However, it is an annual cash cost.

Licence Fees.- Which are for trucks and tractors are treated as an annual operational cost.

Capital or Overhead Costs

The costs of owning a machine are commonly referred to as the capital

or overhead or non-cash costs, such as the costs of:

(i) Depreciation

(ii) Interest on invested capital

(iii) Housing.

These costs must be considered regardless of whether the machinery is operated or not. It is possible, however, to delay the expenditure to cover these costs during a period of recession. They are, however, real costs and ultimately consideration must of necessity be given them.

Depreciation.- 1/ This is one of the larger costs of machine use. For the machines of this study excluding tractors, trucks, and combines, the costs of depreciation account for 42 per cent of the total cost when operational labour isn't included, or 23 per cent of the total cost when the operator's wage is included. The straight line method of arriving at the net depreciation is used in this study, i.e., the replacement cost of the machine less the scrap or residual value is divided by the estimated number of years the machine will be used. Prolonging the useful life of a machine by exercising proper care will, therefore, reduce the annual overhead costs of the machine by spreading the replacement cost over more years of service.

Interest on Capital Invested.- This is not as readily appreciated by farm operators as is the cost of depreciation but nevertheless it must be considered. Each machine represents an investment. The efficient farm operator invests only in machinery that will be productive enough to earn a satisfactory return for money invested. If a farmer does not invest money in farm machinery he could theoretically invest it in some other enterprise, possibly off the farm, say in a farm mortgage. The expected return on money invested in a farm mortgage would be about five per cent. The rate of return on an investment is governed more or less by the risk involved. Farming has approximately the same risk as farm mortgages and therefore it is suggested that a return of five per cent on the invested capital in a farm is not out of line. This is the rate that was applied to the average investment in the machinery of this study.

This cost is worked out on the average value of the machine during the year of the study. The average value of a machine during the past year can be arrived at by adding the value of the machine a year ago to the value of the machine today and then dividing by two. If five per cent is taken of this average value the annual cost for interest on invested capital is obtained.

A lower investment in farm machinery is another means of reducing capital costs. Oversize machinery should not be purchased as they require additional power and therefore necessitate a tractor of an uneconomical size. Buying used equipment, if in good repair, offers possibilities of reducing the investment.

Housing.- This is an overhead cost that is usually calculated by distributing the annual costs of the machine shelter or shed among the machines

1/ See Appendix for a discussion on depreciation of farm machinery.

housed, in proportion to the floor space occupied by these machines. The value of housing machines is debatable. Housing machinery offers working conditions which are preferred at times for making necessary repairs. However, when a shelter is not rainproof and, or, when poultry use the sheltered machines for roosts, depreciation is often at a faster rate. A machine, if it is well oiled and its polished surfaces well greased, will in most cases withstand the vagaries of our Alberta climate to a satisfactory degree. Data collected for this study regarding the advisability of housing were non-conclusive, for only a small proportion of the farms house their machinery. As a general rule only the trucks and tractors were housed and these at times in shelters of questionable worth. Only 58 per cent of the farms reported having a machine shelter, the average value of which was $369. Since few of the other farm machines were housed, no consideration was given to the cost of housing in Table 6 where the costs are presented.

Table 6 gives the average use and the cost of using the various machines included in this study. Cost is expressed for 100 hour units for tractors, 100 bushels for threshing machines, 100 miles for trucks, and 100 acre units for other machines. If the cost is desired for each hour, each bushel, each mile, or each acre, the dollars may be read as cents.

The figures presented in Table 6 are averages. This fact should be remembered when any reference is made to them. Machine costs vary considerably between different operators. The more efficient farmers reduce costs per unit of service by: taking proper care of their equipment, prolonging the useful life and increasing the annual hours of use of their machines.

Costs also vary between machines of differing sizes. Table 7 shows the difference in the costs of the tractors and trucks of varying sizes. It cost less per hour to operate a two-plow tractor than a four-plow size, for example.

A tractor with lower costs per hour will not necessarily have a lower per acre cost, however. When other equipment of the proper size is used it is possible to have per acre costs lower for the larger equipment providing the farm is large enough to justify its use. As an example of this, consider a three-plow gas tractor which costs $1.35 per hour of operation and the 4-5 plow gas tractor which has an average of $1.62 per hour excluding the cost of the operator. These costs will become $1.85 and $2.12 per hour respectively if the operator's labour is valued at 50 cents an hour. A three-plow tractor will plow 1.7 acres when pulling three 14 inch bottoms at four miles per hour while the 4-5 plow tractor pulling five 14 inch bottoms at the same rate per hour will plow 2.8 acres per hour. The cost of the operator and tractor are then approximately 11 cents per acre for the smaller tractor and about seven and one-half cents per acre for the larger tractor. The larger tractor would then be the most economical providing it is worked an adequate number of hours. The recommended hours a machine should be used is discussed in the following section.

Attention should be drawn to the fact that the cost figures shown in Table 7 are averages. It is not uncommon to find a farm operator with costs 20 per cent below the average while another farmer, who is not as efficient or has other less advantageous factors of production, may have costs as much as 20 per cent above.

Table 6.- Cost and Annual Use of Farm Machines per Unit of Service a/, Machinery Study, Alberta, 1950

Machine	Average Annual service per machine	Cash operating costs: Fuel, oil, grease, etc.	Cash operating costs: Repairs	Capital costs: Depreciation	Capital costs: Interest charge	Total cost per unit a/	Depreciation rate	Number of machines in sample
		- dollars -		- dollars -		- dollars -	- per cent -	
Power:	- hours -							
Tractors	514	55.70	13.84	33.53	13.88	116.95	6.90	256
	- miles -							
Trucks	8,405	3.53	1.44	2.30	.78	8.05	6.72	122
Tillage machines:								
Blade weeders	824	.20	3.16	4.40	1.82	9.58	7.14	25
Cultivators	420	.46	4.32	4.24	1.72	10.74	5.87	83
Discs (single)	314	1.40	8.32	5.28	1.84	16.84	5.44	19
Discs (double)	209	1.18	5.03	6.90	2.42	15.53	4.74	54
Drills	253	1.01	3.09	11.80	4.42	20.32	5.30	82
Drills (press)	488	.97	5.99	13.64	3.55	24.15	9.18	23
Harrows	410	-	.96	.72	.45	2.13	3.85	87
Oneways	574	1.76	5.00	9.54	3.26	19.56	7.36	186
Packers	344	-	1.13	2.60	.95	4.68	4.45	19
Plows	88	1.24	26.22	17.66	9.96	55.08	4.80	74
Rod weeders	712	.15	2.08	3.11	1.12	6.46	7.78	19
Harvesting machines:	- acres -							
Binder	152	1.52	20.63	21.04	5.86	49.05	5.62	101
Combines A.M.	620	14.21	28.27	49.74	11.49	103.71	6.27	38
S.P.	798	19.12	18.89	65.32	19.47	122.80	11.42	29
Swathers	379	1.23	5.32	16.85	6.90	30.30	8.40	20
	- bushels -							
Threshing machines	107	-	.79	.58	.28	1.65	3.45	23

a/ Per 100 hours for tractors, per 100 bushels for threshing machines, per 100 miles for trucks and per 100 acres for other.

Table 7.- Costs per Unit of Service[a] of Varying Sizes of Tractors and Trucks, Machinery Study, Alberta, 1950

Machine	Size	Costs: Fuel, oil grease, etc.	Costs: Repairs, depreciation, and interest	Costs: Total
		- dollars -		
Tractors	- plows -			
	1 to 2-3 gas	35.99	48.58	84.57
	1 to 2-3 distillate	45.63	49.46	95.09
	3 and 3-4 gas	59.64	54.11	113.75
	3 and 3-4 distillate	68.18	67.08	135.26
	4 and up gas	80.03	82.23	162.26
	4 and up diesel	39.49	95.04	134.53
Trucks	- tons -			
	½ and ¾	2.77	3.15	5.92
	1	3.25	3.95	7.20
	1½ and 2	4.04	6.03	10.07
	2½ and 3	4.83	5.83	10.66

a/ Per 100 hours for tractors and per 100 miles for trucks.

RECOMMENDED SIZE OF FARM MACHINERY

The size of farm machinery to select when equipping a farm is a problem that is often faced by farm operators. The field machines should be of such a size as to complement the size of the tractor selected. The problem then is, what size of a tractor should a farmer operate? In a report of this nature this question can only be approached in a general manner with emphasis being placed on points to consider.

Generally speaking the tractor should be chosen so that it will give optimum satisfaction to the farmer. Many operators choose a machine of a particular make and type because they are familiar with it and have found its performance satisfactory. This personal preference is a factor which is of value because it does affect the cost of operation. A farmer who knows his machinery is better equipped to get the most from it.

A machine should be chosen, however, of such a size that the costs per unit of service are as low as possible. As a rule the greater the number of hours a machine is in operation, the lower is the per hour cost. It is not possible to extend the seasonal use of many farm machines indefinitely. Many of the farm jobs are seasonal and must be completed within a limited time or the resulting yield suffers. The machine, or machines, must, therefore, be large enough to complete the required work in the time available with the available labour force.

When the wages are high a farmer should choose his machinery so that he can get his many jobs done on time, using as little hired help as possible. A balance between expenditures for labour and equipment that results in low total operating costs is desired. If a farm operator attempts to get low operating costs by using a machine which is too small he may lose part of his crop or spend more for extra labour than it would cost to provide a larger machine.

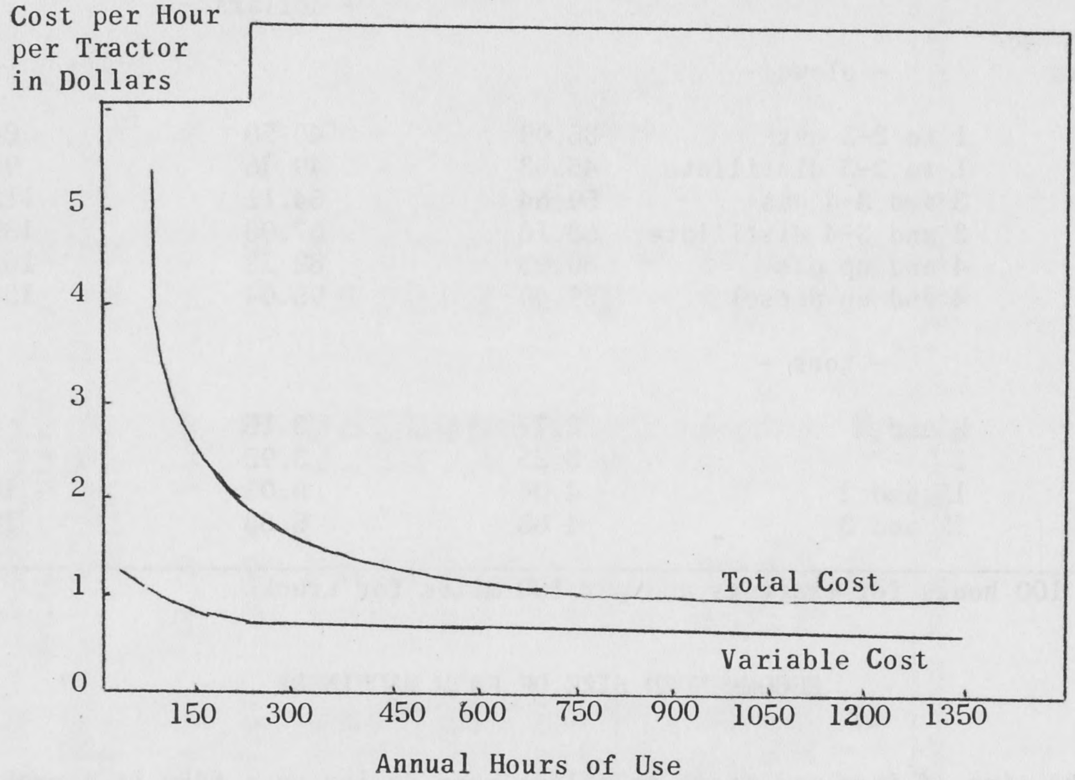


Figure 5.- Relationship Between Total Cost of Operating 256 Tractors and Hours of Use, Machinery Study, Alberta, 1950

Figures 1, 2 and 3, showed the variation of tractor use in this study. It was noted that more than one-half of the machines were used less than the average number of hours. Figure 5 shows the effect on the costs, of operating tractors for differing periods. The cost figures for 256 tractors were used to obtain these average curves. Two curves appear, the lower being the curve indicating the effect of hours of use on the variable cash costs, not including an allowance for the operator's wage, and the other indicates the effect on the total cost of varying hours of use. It is notable that the lower curve approaches a straight horizontal line which indicates that the variable costs of fuel, oil, grease, repairs, etc., are nearly in direct proportion to the hours of use. The total cost per unit of service as indicated by the upper curve decreases as the hours of use increase. This decrease is at a faster rate at the beginning of the curve when hours of use are low. The difference in the proportional decrease between curves is due to the effect of the capital costs. These overhead costs are not nearly as dependent on the hours of use as are the variable cash costs. The curves tend toward a horizontal straight line, that is the proportional decrease in cost approaches zero.

As the hours of use are increased above the average of 526 hours the decrease in total cost is very small. As a general rule then, it is suggested that a farmer should choose his tractor of such a size that he obtains at least the average number of hours or slightly more. This is also offered as a rule of thumb for other farm machinery, that is, invest in machinery only when there is the average acres or hours of work; otherwise the cost will be high and an alternative such as hiring the work done on the custom basis may be preferred. It is not suggested that the hours of use be much above the average unless this can be obtained without other enterprises suffering. For example, the tractor should have sufficient power to pull a drill which is wide enough to get the crop in on time.

The average annual service of the 17 farm machines of differing sizes are listed in Table 6. These are average units of service so an adjustment may be necessary for an individual farm. Extra power is required for various reasons, such as hilly land and heavier textured soils.

CUSTOM USE OF FARM MACHINERY

The practice of many farmers of doing custom work for neighbours is an effective means of increasing the annual use of implements. Equitable charges to be paid or received for custom work are of interest to these farmers.

A summary of the 1950 rates are presented in Table 8. It will be noted that harvesting operations are the most common type of work done on a custom basis, and with the exception of breaking these are the only type of work reported. Trucking charges were reported on a per bushel per mile basis and so can be considered as a harvesting operation. The average distance to grain elevators reported by farmers having custom trucking done was approximately nine miles.

Table 8.- Custom Rates Reported, Machinery Study, Alberta, 1950

Type of work	Units	Range		Average (mean)	Most common (mode)	Number in sample
				- dollars -		
Combining	per acre	1.25 to	4.00	2.31	2.00	66
Threshing	per hour	8.00	14.00	11.32	12.00	34
Threshing	per bus. of wheat	.09	.16	.115	.11	18
Trucking	per bus. per mile	.0021	.02	.0048	.005	61
Breaking	per acre	3.00	15.00	8.50		7
Swathing	per acre	.75	1.50	1.08	1.00	15

Suggested custom rates have been calculated based upon the costs of the various implements and these appear in Table 9. These rates are based upon the average costs of the machines of the four zones studied. It should be

understood, however, that any suggested rates can serve only as a guide. This is due to the differing costs which are peculiar to different districts, in fact to different farms.

When a farmer does custom work for his neighbours the drive down the road with the outfit is an additional expense. A hard, rough road often causes more wear and tear per mile than many miles in a cultivated field. Time is also required to get the machine ready and to move it to and from the field. An allowance must be made for this additional wear, the time in moving, and also a profit to the owner. It is estimated that an additional charge of 20 per cent of the other costs will cover this added expense. In Table 9 a column headed "Plus 20 per cent" is included to compensate for this charge.

Table 9.- Suggested Custom Rates per Acre for Doing Work with Various Types of Equipment, Alberta, 1950

Kind of machine	Cost per acre					Suggested rates per acre
	Use of machine	Power	Labour at 50 cents per hour	Plus 20 per cent	Total	
	- dollars -					
Tillage machines:						
Blade weeder	.10	.32	.12	.11	.64	.65
Cultivator	.11	.34	.15	.12	.72	.70
Single disc	.17	.23	.09	.10	.59	.60
Double disc	.16	.36	.16	.13	.80	.80
Drill	.20	.28	.14	.12	.74	.75
Press drill	.24	.29	.12	.13	.78	.80
Drag harrows	.02	.15	.07	.05	.29	.30
Oneway	.20	.50	.20	.18	1.08	1.10
Packers	.05	.30	.16	.10	.61	.60
Plow	.55	.89	.40	.37	2.21	2.20
Rod weeder	.06	.20	.09	.07	.42	.40
Harvesting machines:						
Binder	.49	.42	.43	.27	1.62	1.60
Combines A.M.	1.04	.28	.11	.28	1.70)	1.70
S.P.	1.23	-	.12	.27	1.62)	
Swather	.30	.19	.09	.12	.70	.70

CO-OPERATIVE OWNERSHIP OF FARM MACHINERY

Co-operative use of farm machinery was another means whereby some of the interviewed farmers lowered production costs, especially when the original costs of the machine was great and the number of days of annual use were few. This opportunity to lower the cost per unit of work was especially favoured by operators of small farms. Ownership of larger, more expensive, labour-saving machinery was thereby made possible for these farmers who otherwise would have had to borrow or hire machines.

In times when the supply of machinery is limited co-operative ownership and use is of particular value in offsetting the shortage as well as aiding in increasing production at a lower cost. Co-operative ownership is often discouraged, however, by the desire to be independent of other farms, by possible friction as to who will use the machine first, and by failure to keep the machine in repair.

COMPARATIVE COSTS OF TYPICAL SEQUENCES OF FIELD OPERATION IN THE FOUR ZONES

Four of the six soil zones, as stated earlier, are covered by this study. The type of farming and the farming practices vary with these zones. A comparison of typical sequences of field operations which differ with each area studied as well as the comparative costs of these sequences is given here.

The Brown Soil Zone

This zone, which is found in the southeastern part of the provinces, has a semi-arid climate with moisture as a limiting growth factor. The dryland of this area is mainly used for ranching and wheat production. This is the zone of the larger wheat farms of the province. The average size of farms of this zone is the largest of the province.

The sequence of field operations varied with operators. In the brown soil zone the average number of tillage operations on summerfallow was less than the other zones, due to the lower rainfall, with less resultant weed growth. Tables 10, 11, and 12 show three sequences of field operations on summerfallow typical to this zone, with comparable costs of each. The rates per hour and the costs are based upon the survey data. Machinery as used with the 3-4 plow tractor, is most common to this zone. The cost of the operator's labour is not included.

Table 10.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Brown Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (8½ ft.)	3.4	.14	.40	.54
Oneway (8½ ft.)	3.4	.14	.40	.54
Blade weeder (11 ft.)	4.2	.10	.32	.42
Total				1.50

Table 11.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Brown Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (8½ ft.)	3.4	.14	.40	.54
Blade weeder (11 ft.)	4.2	.10	.32	.42
Blade weeder (11 ft.)	4.2	.10	.32	.42
Total				1.38

Table 12.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Brown Soil Zone, 1950 (Sequence C)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (8½ ft.)	3.4	.14	.40	.54
Blade weeder (11 ft.)	4.2	.10	.32	.42
Rod weeder (24 ft.)	7.6	.07	.19	.26
Rod weeder (24 ft.)	7.6	.07	.19	.26
Total				1.48

As with the field operations for summerfallow the other field operations vary. In Tables 13 and 14 the cost and time required for seeding and harvesting, using two varying methods, typical to the brown soil zone, are shown.

Table 13.- Typical Sequence of Tilling and Harvesting Showing Time Required and Costs, Brown Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Tiller and packer (8½ ft.)	3.4	.18	.40	.58
Combine A.M. (16 ft.)	4.3	1.17	.32	1.49
Total				2.07

The most common size of tractor is again used, namely the 3-4 plow size. It will be noted that the auxiliary motored combine is used in Table 13 while the self-propelled combine is used in Table 14. Both types of combines are common and the difference in cost is of interest. The cost of the auxiliary motored combine is higher than expected due to the increased fixed costs per acre caused by the limited number of hours of use of these machines as compared to the other combines listed.

Table 14.- Typical Sequence of Tilling and Harvesting Showing Time Required and Costs, Brown Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Single disc (21 ft.)	6.0	.16	.23	.39
Press drill (14 ft.)	5.2	.24	.27	.51
Combine S.P. (14 ft.)	4.2	1.20	-	1.20
Total				2.10

The Dark Brown Soil Zone

This zone borders the brown zone, and is a transition between the brown and shallow black zones. Moisture is still the principal limiting growth factor but this zone suffers fewer droughts than the brown zone and has a slightly higher annual precipitation. As in the brown zone, the cropped land is generally sown to wheat but the farms of this zone are usually smaller.

As in the brown soil zone the sequence of field operations varies considerably. The 3-4 plow tractor is the most common and this is used as the typical tractor in the following tables pertaining to this zone. Two typical sequences of summerfallow operations are shown in Tables 15 and 16.

Table 15.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Dark Brown Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (8½ ft.)	3.4	.14	.40	.54
Oneway (8½ ft.)	3.4	.14	.40	.54
Cultivator (12 ft.)	4.4	.09	.30	.40
Total				1.48

Table 16.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Dark Brown Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway(8½ ft.)	3.4	.14	.40	.54
Cultivator (12 ft.)	4.4	.09	.31	.40
Cultivator (12 ft.)	4.4	.09	.31	.40
Cultivator (12 ft.)	4.4	.09	.31	.40
Total				1.74

In the dark brown soil zone the sequence of seeding operations is varied. This variation is due mainly to differences in managerial preferences, availability of machinery, differences in weather and cropping practices. In the brown soil zone it is the rule to seed only land which has been summerfallowed the preceding year. In the dark brown soil zone, however, the practice of sowing part of the crop on the previous year's stubble land is not uncommon. When the stubble land is cropped the preparations of the seed bed differ. This difference is apparent when a comparison is made of the three typical sequences of operations as outlined in Tables 17, 18, and 19. Harvesting operations in the zone are confined almost solely to combine harvesting.

Table 17.- Typical Sequence of Seeding Operations on Summerfallow Land, Showing Time Required and Costs, Dark Brown Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Tiller (8½ ft.)	3.4	.14	.40	.54
Total				.54

Table 18.- Typical Sequence of Seeding Operations on Summerfallow Land, Showing Time Required and Costs, Dark Brown Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Harrow (24 ft.)	9.5	.03	.14	.17
Drill (14 ft.)	5.1	.17	.23	.40
Total				.57

Table 19.- Typical Sequence of Seeding Operations on Stubble Land Showing Time Required and Costs, Dark Brown Soil Zone, 1950

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
		- dollars -		
Double disc (10 ft.)	3.4	.14	.40	.54
Harrow (24 ft.)	9.5	.03	.14	.17
Drill (14 ft.)	5.1	.17	.23	.40
Total				1.11

The Shallow Black Soil Zone

This zone is characterized by a heavier precipitation than either of the brown zones with, as a result, a heavier native vegetation. There is more diversification in cropping practices than in the brown and dark brown soil zones but wheat is still the principal crop grown. Livestock is more commonly kept by the farmers of this zone than of the two preceding zones. The average farm of this zone is smaller in total size and also crop acreage than farms typical of the two more arid zones.

More moisture with heavier resultant weed growth necessitates an increase in field operations in this zone as compared to the brown and dark brown soil zones. This addition to the costs of farming of the shallow black soil zone is compensated for by a higher average crop yield than the average of the brown and dark brown zones.

Two typical sequences of field operations on the land being summerfallowed are shown in Tables 20 and 21. In this zone, as in the black soil zone, the most commonly used tractor is of the three-plow size. The costs of this size of tractor with complementary machinery are given in the following tables.

Table 20.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Shallow Black Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of Tractor per acre	Total cost per acre
		- dollars -		
Oneway (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Oneway (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Cultivator (10 ft.)	3.7	.12	.32	.44
Total				2.40

Table 21.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Shallow Black Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Plow (3 bottom)	1.2	.61	.93	1.54
Cultivator (10 ft.)	3.7	.12	.32	.44
Cultivator (10 ft.)	3.7	.12	.32	.44
Harrow (21 ft.)	7.2	.02	.16	.18
Total				2.60

In this zone the crops are sown on summerfallowed land with a proportional increase in the acreage sown on land which was cropped the preceding year as compared to the brown and dark brown soil zones. The costs and time required for two typical sequences of spring operations are shown in Tables 22 and 23.

Table 22.- Typical Sequence of Seeding Operations on Summerfallowed Land, Showing Time Required and Costs, Shallow Black Soil Zone, 1950

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Harrow (21 ft.)	7.2	.02	.16	.18
Drill (14 ft.)	5.1	.17	.23	.40
Harrow (21 ft.)	7.2	.02	.16	.18
Total				.76

Table 23.- Typical Sequence of Seeding Operations on Stubble Land, Showing Time Required and Costs, Shallow Black Soil Zone, 1950

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (6 ft.)	2.0	.23	.57	.80
Drill (14 ft.)	5.1	.17	.23	.40
Harrow (21 ft.)	7.2	.02	.16	.18
Total				1.38

In the shallow black soil zone the binder and threshing machine are still used, but the most common method of harvesting is by swathing and combining.

The Black Soil Zone

This zone is north and west of the other three zones and has a higher annual precipitation and is the most fertile zone in the province. Mixed crop-livestock farming is more common to this zone than to the other three zones. The farms have the smallest total acreage and crop acreage of the four zones considered in this study.

The difference in the sequence of field operations on summerfallowed land is indicated in Tables 24 and 25. Generally speaking it can be said that deeper cultivation is the practice in this zone.

Table 24.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Black Soil Zone, 1950 (Sequence A)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Oneway (6 ft.)	2.0	.23	.57	.80
Cultivator (10 ft.)	3.7	.12	.32	.44
Cultivator (10 ft.)	3.7	.12	.32	.44
Total				2.66

Table 25.- Typical Sequence of Summerfallow Operations Showing Time Required and Costs, Black Soil Zone, 1950 (Sequence B)

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Plow (3 bottom)	1.2	.61	.93	1.54
Harrow (21 ft.)	7.2	.02	.16	.18
Oneway (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Total				2.70

In this zone a larger percentage of the crops is grown on stubble land than on land which was summerfallowed the preceding year. Two typical sequences

of seeding operations are shown in Tables 26 and 27, one on land which was summer fallowed and the other on land which was cropped the year before.

Table 26.- Typical Sequence of Seeding Operations on Summerfallowed Land, Showing Time Required and Costs, Black Soil Zone, 1950

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Tiller (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Total				.98

Table 27.- Typical Sequence of Seeding Operations on Stubble Land, Showing Time Required and Costs, Black Soil Zone, 1950

Operations	Acres covered per hour	Cost of operating machine per acre	Cost of tractor per acre	Total cost per acre
			- dollars -	
Oneway (6 ft.)	2.0	.23	.57	.80
Harrow (21 ft.)	7.2	.02	.16	.18
Drill (14 ft.)	5.1	.17	.23	.40
Total				1.38

In the black soil zone the binder is still the most common method of harvesting the crop. It is not uncommon, however, to find the swather and combine being used but not to the same extent as in the other zones.

The differing sequences of field operations common to each of the four zones studied suggest a comparison of the costs of field operations per acre for these four areas. A straight comparison, however, is not justified, due to differing cropping practices. The ratio of summerfallow to crops seeded varies with the zones, with the ratios being for the brown soil zone 1:1.06; for the dark brown soil zone 1:1.90; for the shallow black soil zone 1:2.00; and for the black soil zone 1:2.63. If the costs of summerfallowing operations are distributed in the proportions suggested by these ratios a comparison of the costs of the field operations for summerfallowing and spring seeding and cultivating may be made and is shown in Table 28. As the proportion of cropped acres to summerfallow increases the trend is for the cost of summerfallowing per acre of crop to decrease. The cost of summerfallowing per acre of crop in the dark brown soil zone does not, however, adhere to this trend.

Table 28.- Comparative Costs of Field Operations per Acre of Crop Covering Summerfallow and Spring Work for the Four Main Soil Zones, Alberta, 1950

Operations	Soil zone: Brown	Dark brown	Shallow black	Black
	- costs per acre of crop in dollars -			
Summerfallowing	1.37	.84	1.25	1.02
Spring work:				
(seeding and cultivation	.74	.98	1.07	1.27
Total	2.11	1.82	2.32	2.29

A better understanding of the results shown in Table 28 is possible when the hours spend on the field operations are considered. The hours for the operations of summerfallow and spring work per acre of crop are shown in Table 29. It is noted that the hours spent on summerfallowing operations per acre of crop is lowest for the dark brown soil zone. This is the result of, first, the need for cultivation being less due to the small weed growth, and second, the increase in the proportion of acres of crop to acres of summerfallow over the brown soil zone.

Table 29.- Comparison of Hours Required for Field Operations, per Acre of Crop Covering Summerfallow and Spring Work for the Four Main Soil Zones, Alberta, 1950

Operations	Soil zone: Brown	Dark brown	Shallow black	Black
	- hours required per acre of crop -			
Summerfallowing	.80	.47	.76	.58
Spring work:				
(seeding and cultivating)	.34	.50	.42	.76
Total	1.14	.97	1.18	1.34

APPENDIX

Depreciation of Farm Machinery

Depreciation may be defined as an annual allowance which is made to account for the normal wear and tear and loss through obsolescence of farm machinery. Because of the difficulty in measuring the annual loss, it is usually estimated. The main problems of depreciation are attributable to this estimation. As a rule a depreciation rate is adopted and this is applied to either the original or replacement cost of the machinery.

There are two common concepts as to the purpose of depreciation, namely:

(i) Prepaid Expense Concept.- This is the argument that the investment in farm machinery is nothing more than a prepayment of a current expense, which is distributed over the succeeding years at a rate in proportion to the loss in value due to depreciation. At the end of the life of the machine all that is left of the original investment is the residual or scrap value.

(ii) Replacement of Capital Good Concept.- This differs from the first concept in that the purpose of the depreciation expense is that the allowance made for wear, tear, and obsolescence is available for replacement. This concept is an attempt at making a provision whereby the machinery may be kept at par in a physical sense. A farmer can maintain his line of machinery by re-investing his allowance for depreciation in the machinery as it requires replacing. This concept is suggested as being preferred for farm management.

In the calculation of an annual charge or allowance for depreciation, the problem of what cost to base the charge on is faced. The original cost of the good is recommended if one is basing his depreciation on the first concept. However, if the second concept is preferred, then the current replacement cost is mandatory since the machinery pool can be maintained in a physical sense only by recognizing the change in money value. If the current replacement cost is used, then the chosen depreciation rate is applied to this and the allowance for depreciation will reflect the wear, tear, and obsolescence for the accounting period in current dollar values. This is important when the replacement cost varies from year to year. In the case of farm machinery its cost during the past decade has shown a constant increase. If a machine was purchased ten years ago and its life was ten years then it is now fully depreciated. If the allowance for depreciation was calculated on the original cost then the sum available for replacement would not be sufficient due to the increase in the cost of the machine or the comparative decrease in dollar value. If the annual allowance for depreciation had been calculated with the replacement cost as a basis, then more money would be available for the replacement of the machine. There would not, however, be enough for replacement if each of the ten annual allowances for depreciation had been set aside as a reserve fund for replacement. What is recommended is that the annual allowance for depreciation be calculated on the replacement values of all the farm machines. The aggregate sum from the depreciation on all the machines would then reflect the current depreciation in current dollar value. This sum should be immediately re-invested in machinery requiring replacement

or re-invested as near to the period for which it was allowed as possible, thereby enabling the new purchases to be made at the same or nearly the same dollar value as the depreciation. This would result in the line of machinery being kept as close to the desired physical condition as possible.

Another problem that is faced is determining whether the machine has some value after its estimated period of usefulness is complete. In this study only the special machinery, which included the tractors, trucks, combines, swathers, and threshing separators, has been considered as having a residual value. It may be argued that other farm machinery has a scrap value but this value as a rule will be insignificant in the majority of cases. The division is an arbitrary one, however, and for this study was based on the fact that the special machines usually represented a larger investment.

The type of depreciation rate is another problem which has to be decided upon. Two general types of rates are in common practice, viz., a constant or fixed rate which is the same for each succeeding year, and a diminishing rate which permits a larger depreciation amount in the early years of use. Some of the methods of arriving at these differing rates follow:

(i) Present Value or Change in Inventory Method.- This can be arrived at by noting the decrease in value of the particular machine over the past year, or in other words, what was its value at the beginning of the year and what is it worth at the end of the year. This difference in value is the annual depreciation allowance. The difficulty with this method of depreciation is that the farmer must consider resale value of each of his machines each year. Often it is difficult to arrive at a satisfactory value, even with the help of auction sales and local trade-in values.

(ii) Straight-line Method.- This method can be said to be the simplest and for this reason is favoured by many. To calculate a rate all that is necessary is an estimate of the number of years the individual machines will last and then divide this into 100. This rate may then be applied to the replacement cost or the original cost as desired.

(iii) The Diminishing Balance Method.- This can be calculated by adopting a set rate which remains constant over the life of the machine. This rate is applied to the diminishing value of the item from year to year, i.e., the first year the rate is applied to the original cost, the second year it is applied to the depreciated value remaining after the first year, the third year it is applied to the depreciated value remaining after the second year, and so to the last year of use. It is noted that the depreciation allowance will decrease from year to year and also that the machine will always have a residual value. This method generally necessitates a larger depreciation allowance the first few years than is desired if the residual value is to be realistic.

(iv) Reducing Fraction Method.- This is another method of calculating a diminishing depreciation allowance but in this case the rate varies from year to year. It is arrived at by setting up a series of fractions which can be converted to percentage rates. The fractions are obtained by writing down the number of years of estimated life of the machine as: 1,2,3,4,5,6,7,8,9,10, for a machine that will last ten years and summing these numbers, which in

this example equals 55, then for the first year the fraction 10/55 would correspond to the desired rate, the second year the rate would be 9/55 and so on until the last year the rate would be 1/55. This method is adapted so one may have a residual value or not.

(v) Compounded Interest Method.- This method makes use of the sinking fund technique which is the practice of setting up a reserve which earns interest. The interest earned on the reserve will increase annually due to the reserve being increased to the extent of the allowance for depreciation as well as the interest which is re-invested each year. This increasing income from interest is subtracted from the depreciation allowance which is calculated at a fixed rate, thereby causing the net depreciation allowance to decrease with the increasing years of service of the machine.

The advantage of the diminishing depreciation allowance as stated by advocates of this type is that it is more comparable to the actual conditions. That is, a machine that is depreciated more in the earlier years of use will be shown as having a value which is closer to the resale value. The resale value of machines which are, say, one year old are often much below the replacement cost or the price of a similar machine which is new. A machine with an estimated life of say, ten years, may depreciate as much as 30 per cent the first year on the resale market even though it has been used very little during that period. This high depreciation is due to the apparent obsolescence factor. The basis for obsolescence is technological advancement which improves the efficiency of a machine. The cost of obsolescence should be then, in a direct proportion to this advancement which can be considered to be at a constant rate, not a diminishing rate. However, in the case of the resale of automobiles there is the additional factor of "keeping up with the Joneses". This human factor does not affect the real value of farm machinery however. A farmer buys machinery to use, not to re-sell. As a rule a farmer is not a speculator in farm machinery. For this reason it is more realistic to consider his depreciation as being in proportion to use and obsolescence due to the accumulative technological advances. When this is done the straight-line method of arriving at a rate for depreciation allowance is most realistic and was used in the calculations of this study. When a comparison is made between various farm enterprices from year to year it is more equitable to consider the depreciation on the straight-line basis than on a diminishing rate basis.

The methods of arriving at a rate for the depreciation allowance discussed above, all give as a result a net depreciation amount. Many workers in farm accounting prefer a gross rate so that they may be able to adjust it by a consideration being given to the appreciation caused by repairing the machine. If repairs are to be considered as appreciation it is then necessary to consider the differing types of repair work carried out as all repairs are not of an appreciative nature.

There are repairs which may be called capital repairs, that is, repairs that do appreciate the machine. Examples of these are new tires for a tractor, a rebuilt or overhauled engine, a new sickle in a mower, etc. Repairs of this type lengthen the life of a machine and thereby increase its value. The problem is to decide the extent they do appreciate the machine. This appreciation can be estimated by noting the frequency of the repair or replacement of parts.

A new tractor tire may last five years. In this case one can say that the tractor has been appreciated by the unused tire which remains at the end of the year, or approximately four-fifths of the value of the tires. In the case of a new sickle on a mower the appreciation may be about 50 per cent of the value of the sickle if the sickle is replaced every two years.

There are other repairs which are of a recurring nature and can be treated as a current expense. In the case of a tire, a vulcanizing job to repair a cut can be considered as a current expense with no appreciation value. Every year a farm operator who uses his hay mower regularly finds that a few new sections of the sickle may need replacing. This replacement, in that it is done every year, does not appreciate the machine and so the repair is not considered as having any appreciation value. Many other examples could be given but these few should suffice.

Cognizance was taken of the fact that some repairs increased the value of the machine, when the data were collected for this study. Based on a sample of 256 tractors, the appreciation due to repairs amounted to approximately 45 per cent of the total cost of repairs. With the sample of 122 trucks the appreciation amounted to nearly 60 per cent of the total repair cost. The sample of 62 combines indicated an appreciation of about 50 per cent, while the sample of 17 swathers appreciated by nearly 25 per cent of the repair bill. The sample of 25 threshers indicated that the majority of thresher repairs are of a current nature as the amount of appreciation was about 25 per cent. In the case of the other machines which were grouped as general machinery a sample of 2,984 machines showed that only 25 per cent of the total repair cost was of an appreciative character.

With these rates it is possible to apply a gross depreciation rate of the machinery and then appreciate the resulting gross amount by the value of the capital repairs to arrive at the net depreciation allowance. As an example, a tractor which would cost \$2,500 to replace and having a gross depreciation rate of eight per cent (as shown in Table 30) and a total repair bill of \$200, would have the allowance for net depreciation equal to: $(\frac{8}{\$110} \times 2{,}500) - (\frac{45}{100} \times 200) = \$100.$

In arriving at the appreciation rate for repairs as shown in Table 30 it was necessary to decide whether a constant or increasing rate is desirable. The constant rate is preferred. This preference is due to the fact that repairs are a result of wear with the exception of replacement due to breakage. Every hour a machine is used causes wear. In time parts have to be replaced due to this wear. Wear is in direct proportion to use so the charge for repairs should be in a straight-line proportion; that is, repairs are chargeable at a fixed amount per hour of use regardless of the age of the machine in years or in hours of use. The rates for the appreciation due to repairs as shown in Table 30 are based on this argument and on the assumption that the average hours of use as found in this study would be the same as the average hours of use per year for the lifetime of the machine in question.

Table 30.- Depreciation Rates as a Percentage of Replacement Cost of Particular Machines or Machine, Alberta, 1950

Machine	Net depreciation rate	Appreciation rate due to repairs	Gross depreciation rate
		- per cent -	
Tractors	7.0	1.0	8.0
Trucks	6.5	2.5	9.0
Combines	8.0	1.5	9.5
Swathers	8.5	0.5	9.0
Threshers	3.5	0.5	4.0
General equipment	5.0	1.0	6.0

A choice must be made as to what depreciation rate is applied, the gross rate or the net rate. It is suggested that the decision as to the desired rate be dependent upon the results required. If an individual farm business record is being analyzed then the gross rate would be desirable with the appreciation due to repairs being calculated in the manner of the above example. This would result in a more realistic income figure. If, on the other hand, a sufficiently large group of farm business records are being analyzed, resulting in an average budget, then the net depreciation rate is suggested as preferable due to the simplicity, with no further consideration being given to repairs as an appreciation item and also due to the net depreciation rate accounting for appreciation due to repairs.